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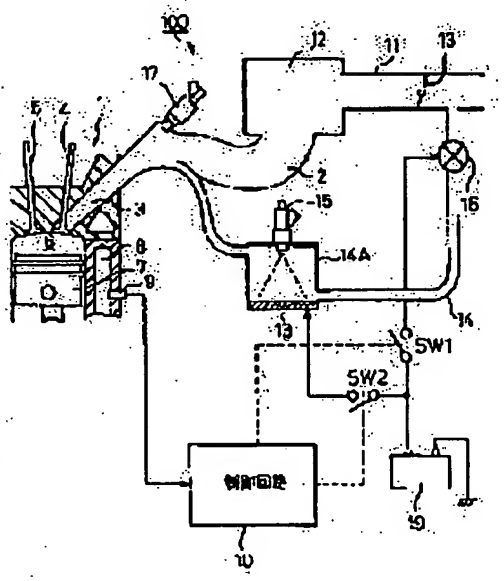
(54) AUXILIARY FUEL SUPPLY DEVICE

(57)Abstract:
PURPOSE: To accelerate fuel atomization under a low temperature state without deteriorating intake efficiency in an engine provided with a sub-intake passage having a sub-fuel injection valve arranged parallelly to a main intake passage having a main fuel injection valve.

CONSTITUTION: A sub-intake passage 14 which has a sub-chamber 14A and an opening/ closing valve 16 is arranged parallelly to a main intake passage 11 as an auxiliary fuel supply device in an internal combustion engine 1 provided with a main fuel injection valve 17 in the main intake passage 11. A sub-fuel injection valve 15 and a PTC heater 18 opposed thereto are provided as a part of a wall surface in the sub-chamber A. In addition, an engine temperature sensor 9 is provided. By a control circuit 10 which control them, the opening/closing valve 16 is opened under the low temperature state of the engine, and at the same time injection is performed from the sub-fuel injection valve 15 and current carrying to the PTC heater 18 is performed. The valve 16 is closed under the high temperature state of the engine, at the same time injection from the sub-fuel injection valve 15 and current carrying to the PTC heater 18 are stopped. Fuel atomization is accelerated in a low temperature state while improving intake efficiency. Injection from the main fuel injection valve 17 is possible even under a low temperature state of the engine.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] A subinhalation-of-air path is established in juxtaposition about an auxiliary fuel supply system at the main inhalation-of-air path of the internal combustion engine for which the main-fuel injection valve was prepared, and especially this invention relates to the auxiliary fuel supply system which supplies an auxiliary fuel in this subinhalation-of-air path.
[0002]
[Description of the Prior Art] Conventionally, like at the time of an internal combustion engine's starting between the colds, after the internal combustion engine has got cold, since it is hard to evaporate the fuel injected to the inhalation-of-air path, even if it injects the fuel corresponding to an inhalation air content, the air-fuel ratio (air-fuel ratio for a gaseous phase) by the fuel and inhalation air content which were actually evaporated will be in a Lean condition. So, in order to compensate Lean-ization of this air-fuel ratio, when it is in the condition in which the engines at the time of starting between the colds etc. got cold, a lot of fuels than the fuel quantity corresponding to an inhalation air content are injected, and the evaporation fuel required for ignition is supplied to the combustion chamber.
[0003] However, if a lot of fuels are injected in this way at the time between [of an internal combustion engine] the colds, since a lot of fuels will be supplied to a combustion chamber, in exhaust gas, a lot of unburnt components (HC) will be contained. In order to prevent this, while form the electric-type heater for fuel heating which crosses a bypass path in this bypass air duct in the starting system of the internal combustion engine for which the control valve which adjusts the amount of air circulation according to engine temperature to the bypass air duct which bypasses the throttle valve of an inlet pipe was prepared and energizing at an electric-type heater at the time of an engine's low temperature, a control valve opens, and there is a proposal which evaporation of a fuel helps [proposal] and raises an engine's startability (refer to JP,63-150465,A).
[0004]
[Problem(s) to be Solved by the Invention] However, since the electric-type heater for fuel heating which crosses this path was formed in the bypass air duct with the equipment of a proposal at this JP,63-150465,A, this electric-type heater became aisle resistance, and there was a possibility that inhalation-of-air effectiveness might fall.
[0005] Moreover, in the condition that a heater does not generate heat since the energization to an electric-type heater is stopped after cooling water temperature rises and an engine's warming up is completed, and this heater does not generate heat, in order to mean that the surface area of an inhalation-of-air path had increased only the surface area of the heater projected to the inhalation-of-air path, the wall surface coating weight of a fuel increased, and the engine performance of an engine's transient was getting worse. That is, at the time of acceleration, aggravation of the responsibility by the supply delay of a fuel took place, and since the fuel adhering to a heater front face was sucked out at the time of moderation and the increment in HC and CO had taken place, although the engine performance when engine temperature is low improved, with conventional equipment, the engine performance when engine temperature rises was falling.
[0006] Then, the subinhalation-of-air path where the subfuel injection valve was prepared in the main inhalation-of-air path in which the main-fuel injection valve was prepared is established in juxtaposition, and in what supplies an auxiliary fuel to an internal combustion engine from this subfuel injection valve, this invention aims at offering the auxiliary fuel supply system which does not degrade the engine performance at the time of an elevated temperature while it can supply the auxiliary fuel evaporated at the time of low temperature to an internal combustion engine, without reducing inhalation-of-air effectiveness.
[0007]

[Means for Solving the Problem] The subinhalation-of-air path which this invention which attains said purpose is an auxiliary fuel supply system in the internal combustion engine by which the main-fuel supply means was formed in the main inhalation-of-air path, and was installed in said main inhalation-of-air path by juxtaposition, The auxiliary fuel-supply means formed in this subinhalation-of-air path, and the closing motion valve of said subinhalation-of-air path, A heating means to counter said auxiliary fuel-supply means, to be arranged, and to constitute the internal surface of said subinhalation-of-air path, While an engine temperature detection means to detect an engine's temperature, and engine temperature operate said auxiliary fuel-supply means and said heating means at the time of the low temperature below predetermined temperature, said closing motion valve is opened. While suspending actuation of said auxiliary fuel-supply means at the time of an elevated temperature with engine temperature higher than predetermined temperature, it is characterized by having the control means which performs clausilium of said closing motion valve.

[0008] Moreover, even if it is a control means at the low-temperature time with engine temperature lower than said predetermined temperature, while supplying the fuel quantity in which the evaporation set up to temperature is possible from said main-fuel supply means and supplying an insufficiency from said auxiliary fuel-supply means, it may be made to control to increase the fuel amount of supply from said auxiliary fuel-supply means preferentially at the time of an engine's load increase.

[0009]

[Function] While a fuel is supplied from the auxiliary fuel-supply means which the subinhalation-of-air path where engine temperature was installed in the main inhalation-of-air path by juxtaposition at the time of the low temperature below predetermined temperature was open for free passage, and was formed in this subinhalation-of-air path according to the auxiliary fuel supply system of this invention Energization is carried out to the heating means arranged flat-tapped with the internal surface of the subinhalation-of-air path which countered the auxiliary fuel-supply means, and promotion of evaporation of the fuel supplied from the auxiliary fuel-supply means is performed. In addition, while actuation of an auxiliary fuel-supply means is suspended at the time of an elevated temperature with engine temperature higher than predetermined temperature, a subinhalation-of-air path is intercepted. Moreover, even if it is engine temperature at the low-temperature time below predetermined temperature, when supplying the fuel quantity in which the evaporation set up to temperature is possible from a main-fuel supply means, while an insufficiency is supplied from an auxiliary fuel-supply means, the fuel amount of supply from an auxiliary fuel-supply means is preferentially increased at the time of an engine's load increase. Consequently, since engine temperature can supply the auxiliary fuel evaporated at the time of an engine's low temperature, without reducing inhalation-of-air effectiveness at the time of low temperature to an internal combustion engine and a heating means does not project in an inhalation-of-air path, the engine performance at the time of an elevated temperature does not get worse, either.

[0010]

[Example] The example of this invention is explained to a detail using an accompanying drawing below. Drawing 1 is the whole block diagram showing the configuration of the auxiliary fuel supply system 100 of one example of this invention. drawing 1 -- setting -- 1 -- a 4-cylinder internal combustion engine and 2 -- an inlet manifold and 3 -- a suction port and 4 -- for a combustion chamber and 7, as for an engine water jacket and 9, a piston and 8 are [an inlet valve and 5 / an exhaust valve and 6 / a coolant temperature sensor and 10] control circuits.

[0011] The main inhalation-of-air path 11 has connected with an inlet manifold 2, and the surge tank 12 is formed while being the main inhalation-of-air path 11. There is a throttle valve 13 in the upstream of a surge tank 12, and the main-fuel injection valve 17 is formed every inlet manifold 2 in the internal combustion engine 1 of this example. The subinhalation-of-air path 14 bypasses a throttle valve 13, is prepared, and is also called a bypass path. Accessory cell 14A is prepared in the middle of the subinhalation-of-air path 14, and the subfuel injection valve 15 is attached in the head-lining section of this accessory cell 14A. Moreover, the closing motion valve 16 which opens and closes this subinhalation-of-air path 14 is formed in the upstream of accessory cell 14A of the subinhalation-of-air path 14, and the heater 18 for heating is formed in the pars basilaris ossis occipitalis of accessory cell 14A.

[0012] It is prepared in the heater 18 for heating as a bottom wall of accessory cell 14A so that it may not become resistance of the inhalation of air which is the instant heating heater formed with the ingredient of a ceramic system and which a PTC heater (Positive Temperature Coefficient Heater) is used, and flows the subinhalation-of-air path 14. It connects with the dc-battery 19 through the switch SW2, and if this heater 18 is energized, it will generate heat. Moreover, the closing motion valve 16 is also connected to the dc-battery 19 through the switch SW1, and if it energizes, the subinhalation-of-air path 14 will be connected to the main inhalation-of-air path 11.

[0013] The water temperature detecting signal from the coolant temperature sensor 9 installed in the control circuit 10 by an internal combustion engine's 1 engine water jacket 8 is inputted, and it judges whether a control circuit 10 is in the condition (condition between the colds) that the engine got cold with the water temperature detection value from

this coolant temperature sensor 9, or it is in standby. And a control circuit 10 heats PTC heater 18 while it makes switches SW1 and SW2 turn on and connects the subinhalation-of-air path 14 to the main inhalation-of-air path 11, when an engine is in the condition between the colds. Moreover, delivery and the subfuel injection valve 15 go a signal also to the subfuel injection valve 15, go an auxiliary fuel to PTC heater 18, and it is made to inject at this time.

[0014] Since an internal combustion engine 1 is a 4-cylinder in fact, the connection with the subinhalation-of-air path 14 and an inlet manifold 2 equipped with accessory cell 14A explained in drawing 1 has become like drawing 2 . That is, the end is connected to the main inhalation-of-air path 11 of the upstream of a throttle valve 13 through the closing motion valve 16, the subinhalation-of-air path 14 branches from accessory cell 14A to four subinhalation-of-air paths 14a, 14b, 14c, and 14d by preparing accessory cell 14A which equipped the center section with the subfuel injection valve 15, and each other end is connected to the inlet manifold 2.

[0015] Here, an example of actuation of the auxiliary fuel supply system 100 constituted as mentioned above is explained using drawing 3 . In addition, by drawing 3 , in order to give explanation intelligible, at the time of cold one, the condition after warming up is put in another way as the time of hot, and the condition that the fuel injection valve for cold one and the internal combustion engine 1 have got cold the fuel injection valve for hot and the subfuel injection valve 15 in the main-fuel injection valve 17 is indicated.

[0016] First, the actuation at the time of cold one is explained. At the time of cold one, it is drawing 3 (a). A throttle valve 13 is closed and the closing motion valve 16 is opened so that it may be shown. And fuel injection is not performed from the fuel injection valve 17 for hot, but a fuel is injected in the condition of having energized to PTC heater 18, from the fuel injection valve 15 for cold. Therefore, the injection rate of the fuel injection valve 17 for hot at the time of cold one is 0%, the injection rate of the fuel injection valve for cold becomes 100%, and only the auxiliary fuel from the fuel injection valve 15 for cold is introduced into a combustion chamber 6.

[0017] On the other hand, it is drawing 3 (b) at the time of hot. A throttle valve 13 is opened so that it may be shown, and the closing motion valve 16 is closed conversely. And fuel injection is performed only from the fuel injection valve 17 for hot, and fuel injection is not performed from the fuel injection valve 15 for cold. Moreover, energization to PTC heater 18 is not performed in this condition, either. Therefore, the injection rate of the fuel injection valve 17 for hot at the time of hot is 100%, the injection rate of the fuel injection valve for cold becomes 0%, and only the main fuel from the fuel injection valve 17 for hot is introduced into a combustion chamber 6. This condition at the time of hot serves as the same configuration as the internal combustion engine 1 for which PTC heater 18 is not prepared, and can lose the bad influence to the transient engine performance at the time of hot.

[0018] An internal combustion engine's 1 cooling water temperature is the temperature between 40 to 60 degrees C at the hot time in the above actuation, and the boundary at the time of cold one is drawing 3 (a). (b) The relation of the water temperature in each condition and the injection rate of the fuel injection valve 15 for cold one and the fuel injection valve 17 for hot becomes as it is shown in the property Fig. shown in drawing 4 . If it thinks also when a car runs immediately after starting, although, as for a problem, the capacity of PTC heater 18 does not become since an inhalation air content is also small if it is the idles operational status at the time of starting etc. in order to use a fuel injection valve properly completely [in the example explained above / in the time of cold one, and the time of hot], therefore there is also little fuel oil consumption, it is necessary to make it what has the quite big output of a PTC heater.

[0019] Next, drawing 1 and another example of actuation of the auxiliary fuel supply system 100 constituted like drawing 2 are explained using drawing 5 . In the condition that the fuel injection valve for cold one and the internal combustion engine 1 have got cold the fuel injection valve for hot, and the subfuel injection valve 15 in the main-fuel injection valve 17, at the time of cold one, this drawing 5 also puts the condition after warming up in another way as the time of hot, and is indicated. In the example explained here, the fuel injection valve 15 for cold and the fuel injection valve 17 for hot are used together at the time of cold one, and the time of hot. It is because extent which the fuel which injected this from the fuel injection valve in the usual internal combustion engine at the time of cold one also has although an evaporation rate is slow is evaporated. Therefore, what is necessary is to give the vaporizable amount in the control circuit 10 as a map to cooling water temperature in 1 cycle, to inject the amount from the fuel injection valve 17 for hot, and just to make it inject an insufficiency from the fuel injection valve 15 for cold in accessory cell 14A.

[0020] First, the actuation at the time of cold one is explained. the time of cold one -- drawing 5 (a) it is shown -- as -- a throttle valve 13 -- the predetermined opening open -- he and the closing motion valve 16 are also opened. And a% of fuel injection is not performed from the fuel injection valve 17 for hot, but b% (=100%-a%) of fuel is injected in the condition of having energized to PTC heater 18, from the fuel injection valve 15 for cold. Therefore, the injection rate of the fuel injection valve 17 for hot at the time of cold one is a %, the injection rate of the fuel injection valve for cold

becomes b%, and the fuel from the fuel injection valve 17 for hot and the fuel injection valve 15 for cold is introduced into a combustion chamber 6 at a predetermined rate.

[0021] On the other hand, it is drawing 5 (b) at the time of hot. A throttle valve 13 is opened so that it may be shown, and the closing motion valve 16 is closed. And fuel injection is performed only from the fuel injection valve 17 for hot, and fuel injection is not performed from the fuel injection valve 15 for cold. Moreover, energization to PTC heater 18 is not performed in this condition, either. Therefore, the injection rate of the fuel injection valve 17 for hot at the time of hot is 100%, the injection rate of the fuel injection valve for cold becomes 0%, and only the main fuel from the fuel injection valve 17 for hot is introduced into a combustion chamber 6. This condition at the time of hot serves as the same configuration as the internal combustion engine 1 for which PTC heater 18 is not prepared, and can lose the bad influence to the transient engine performance at the time of hot.

[0022] Also in the above actuation, an internal combustion engine's 1 cooling water temperature is the temperature between 40 to 60 degrees C at the time of hot, and the boundary at the time of cold one is drawing 5 (a). (b) The relation of the water temperature in each condition and the injection rate of the fuel injection valve 15 for cold one and the fuel injection valve 17 for hot becomes as it is shown in the property Fig. shown in drawing 6 . In the example explained above, in order to use the fuel injection valve the object for cold one, and for hot for coincidence at the time of cold one, as shown in the fuel oil consumption of the fuel injection valve 15 for cold one in accessory cell 14A at drawing 6 , there are allowances also at the time of cold one. Therefore, when a car starts transit during warming up, although an inhalation air content increases rapidly at the time of sudden acceleration, evaporation of a fuel does not catch up in the usual engine, but it is easy to generate the breathing phenomenon by temporary Lean flame failure, but with the equipment of this example, since allowances are in the fuel oil consumption of the fuel injection valve 15 for cold of accessory cell 14A at the time of the acceleration at the time of cold one, an evaporation fuel can be preferentially increased using a part for these allowances. Consequently, since the good fuel of atomization can be supplied in the auxiliary fuel supply system of this example even when a car starts transit during warming up, generating of an engine's breathing phenomenon can be prevented.

[0023] Drawing 7 is a partial expanded sectional view explaining the deformation example of the configuration of accessory cell 14A prepared in the subfuel-supply way 14 of the example shown in drawing 1 . Coating 14B which crawls a fluid is given to the wall part of accessory cell 14A, and what is going to adhere to a wall surface as a drop among the auxiliary fuels injected in accessory cell 14A is dropped on this example from the subfuel injection valve 15 on PTC heater 18 at the bottom. As this coating 14B, surface energy of a fluid is made small and well-known things, such as a fluorine coat with the property which drop by making it a ball, can be used.

[0024] Thus, if the fuel adhering to the wall of accessory cell 14A is flipped and it falls on PTC heater 18, since the rate of atomization of a fuel will improve, a gaseous-phase air-fuel ratio can be efficiently made rich with small fuel oil consumption. Drawing 8 is the whole block diagram showing the configuration of the auxiliary fuel supply system 200 of another example of this invention. Moreover, drawing 9 shows connection with the subinhalation-of-air path 14 and an inlet manifold 2 equipped with accessory cell 14A in case the internal combustion engine 1 of drawing 8 is a 4-cylinder. Since the point that the auxiliary fuel supply system 200 of the example shown in this drawing 8 and drawing 9 differs from the auxiliary fuel supply system 100 of an example explained in drawing 1 and drawing 2 is only the closing motion valve 16 of the accessory cell 14A and the subinhalation-of-air path 14 which were established in the subinhalation-of-air path 14, it gives the same sign to the same configuration member as the example explained by drawing 1 and drawing 2 , and omits that explanation.

[0025] While enlarging the volume of accessory cell 14A, the evaporation fuel is accumulated in this accessory cell 14A, and it enables it to send out an evaporation fuel in the auxiliary fuel supply system 200 of this example also at the time of the acceleration at the time of hot in addition to supplying an evaporation fuel at the time of starting between the colds, and cold one. For this reason, the perimeter of accessory cell 14A is covered with the heat insulator (heat insulating material) 20 so that the vaporized fuel may not get cold. And in order to supply an evaporation fuel to an inlet-manifold 2 side from this accessory cell 14A at the time of the need, the closing motion valves 16A and 16B are formed before and after accessory cell 14A. Closing motion control of these closing motion valves 16A and 16B is carried out by the control circuit 10 like the example of drawing 1 . Moreover, in order to keep constant the temperature of the evaporation fuel in accessory cell 14A, when temperature falls, the switching action of the closing motion valves 16A and 16B may be made to form a temperature sensor in accessory cell 14A, and to energize to PTC heater 18 independently.

[0026]

[Effect of the Invention] In what the subinhalation-of-air path where the subfuel injection valve was prepared in the main inhalation-of-air path in which the main-fuel injection valve was prepared according to this invention as explained

above is established in juxtaposition, and supplies an auxiliary fuel to an internal combustion engine from this subfuel injection valve Since a heating means constitutes the internal surface of a subinhalation-of-air path, it does not become aisle resistance at the time of heating, but is effective in the ability to promote atomization of the fuel at the time of low temperature with slight height in inhalation-of-air effectiveness.

[0027] Moreover, since allowances can be given to fuel supply from an auxiliary fuel injection valve and the quantity of a fuel can be preferentially increased from a subfuel injection valve at the time of an engine's load increase by using both a main-fuel injection valve and a subfuel injection valve at the time of low temperature, and supplying a fuel at it, the good fuel of atomization is supplied to an engine and can respond to a transient effectively by small fuel increase in quantity.

[Translation done.]